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10/573,239	03/22/2006	Artemi Martsinovsky	12096.PCT.US	7195

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EXAMINER	
KIM, JAY C	

ART UNIT	PAPER NUMBER
2815	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/573,239	MARTSINOVSKY ET AL.	
	Examiner	Art Unit	
	JAY C. KIM	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 October 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-8,10-19 and 21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-8,10-19 and 21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 September 2008* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to the RCE filed October 20, 2008.

Claim Objections

1. Claims 3 and 14 are objected to because of the following informalities: on line 1 of claims 3 and 14, "electrode" should be inserted after "the collector". Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 5 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Amended claim 1 recites "said collector electrode consisting of a band gap material" drawn to Fig. 1A of current Application, and therefore it is not enabling that a collector electrode can be formed solely of a dielectric, an alkali metal oxide or an alkaline earth oxide.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1, 3-8, 10-12, 14-19 and 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claims 1 and 12, it is not clear how a band gap material can be used for a collector electrode, and whether the band gap material is heavily doped, because claims 1 and 12 recites “collector electrode consisting of a band gap material”, and a band gap material needs to be heavily doped to be used as an electrode. Claims 3-8, 10, 11 and 21 depend on claim 1, and claims 14-19 depend on claim 12, and therefore claims 3-8, 10, 11, 14-19 and 21 are also indefinite.

6. Claims 3, 4, 14 and 15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claims 3 and 14, it is not clear how “the collector (electrode)” comprises a metal, while amended claims 1 and 12 recite “collector electrode consisting of a band gap material”. Claim 4 depends on claim 3, and claim 15 depends on claim 14, and therefore claims 4 and 15 are also indefinite.

7. Claim 12 recites the limitation "the tunneling range" in a method for promoting tunneling of electrons. There is insufficient antecedent basis for this limitation in the claim. Claims 14-19 depend on claim 12, and therefore claims 14-19 are also indefinite.

8. Claims 18 and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claims 18 and 19, it is not clear whether "a gap" recited in claims 18 and 19 refer to "a gap" recited in claim 12. In the below prior art rejections, it is interpreted that "a gap" recited in claims 18 and 19 refer to "a gap" recited in claim 12.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. Claims 1, 5, 10-13, 16 and 21 are rejected under 35 U.S.C. 102(b) as being anticipated by Cox (US 6,064,137).

Regarding claims 1 and 5, Cox discloses a tunnel diode (Figs. 1g and 5) comprising an emitter electrode (composite layer of 4 and 6) (col. 8, lines 24-25 and 30-31), wherein the emitter electrode (composite layer of 4 and 6) comprises a metal (4), a collector electrode (layer 6 in contact with layer 8), separated from the emitter electrode (composite layer of 4 and 6) by a gap, the collector electrode (6) consisting of a band gap material (6), the band gap material (6) being a crystal material having filled zero

temperature valence band and empty conductive band, wherein the band gap material (6) is a diamond material, and the gap contains only a vacuum (col. 8, lines 54-55).

Regarding claims 1 and 21 (alternate interpretation), Cox discloses a tunnel diode (Figs. 1g and 5) comprising an emitter electrode (4) (col. 8, lines 24-25), wherein the emitter electrode (4) comprises a metal, a collector electrode (layer 6 in contact with layer 8), separated from the emitter electrode (4) by a gap, the collector electrode (6) consisting of a band gap material (6), the band gap material being a crystal material having filled zero temperature valence band and empty conductive band, wherein the gap contains only a vacuum (col. 8, lines 54-55) (claim 1), and in which the emitter (4) has a layer of band gap material (6) deposited thereupon (claim 21).

Regarding claim 10, Cox discloses a vacuum diode heat pump (Fig. 5) comprising the tunnel diode of claim 1 (col. 11, lines 24-29).

Regarding claim 11, Cox discloses a heat to electricity converter (Fig. 5) comprising the tunnel diode of claim 1 (col. 7, lines 54-55).

Regarding claims 12 and 16, Cox discloses a method for promoting tunneling of electrons having an energy level higher than the Fermi level of an emitter electrode (composite layer of 4 and 6 in Figs. 1g and 5) (col. 8, lines 24-25 and 30-31) from an emitter electrode surface wherein the emitter electrode (composite layer of 4 and 6) comprises a metal (4), comprising the step of positioning a collector electrode (layer 6 in contact with layer 8) consisting of a band gap material (6), which is a diamond material, at a distance within a tunneling range of the electrons, which is inherent for the tunneling gap diode (Fig. 1g and 5) to operate, the band gap material (6) being a crystal

material having filled zero temperature valence band and empty conductive band, wherein the emitter electrode (composite layer 4 and 6) is separated from the collector electrode (6) by a gap, the gap containing only a vacuum (col. 8, lines 54-55).

Regarding claim 13, Cox discloses a method for suppressing back tunneling of electrons in a tunnel diode (Figs. 1g and 5) comprising the step of coating a collector (8) (col. 8, lines 27-28) with a layer of a band gap material (6) (col. 8, lines 30-31), the band gap material (6) being a crystal material having filled zero temperature valence band and empty conductive band, and the collector (8) being separated from an emitter (composite layer of 4 and 6) (col. 8, lines 24-25) by a gap, the emitter (composite layer of 4 and 6) comprising a metal (4) and the gap containing only a vacuum (col. 8, lines 54-55).

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 1, 5, 6, 10-13, 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bell (US 4,280,074).

Regarding claims 1, 5 and 6, Bell discloses a tunnel diode (Figs. 2 and 8) comprising an emitter electrode (35) (col. 4, line 59), a collector electrode (composite

layer of 25-27) (col. 3, lines 56-62), separated from the emitter electrode (35) by a gap, the collector electrode (composite layer of 25-27) consisting of a band gap material, the band gap material being a crystal material having filled zero temperature valence band and empty conductive band, wherein the band gap material (composite layer of 25-27) is a semiconductor such as GaAs (col. 4, lines 60-62), and the gap may contain only a vacuum (col. 4, lines 58-59).

Bell differs from the claimed invention by not showing that the emitter electrode comprises a metal.

It would have been obvious, if not inherent, to the one of ordinary skill in the art at the time the invention was made that the emitter electrode disclosed by Bell may comprise a metal, because a metal is commonly used as an emitter electrode material to release electrons.

Regarding claim 10, Bell discloses a vacuum diode heat pump (Fig. 8) comprising the tunnel diode of claim 1, because heat is transferred from the heat source (37) to the heat sink (38) by electron emission from the emitter (35).

Regarding claim 11, Bell discloses a heat to electricity converter (Fig. 8) comprising the tunnel diode of claim 1, because electrons are emitted from the emitter (35) in contact with the heat source (37).

Regarding claims 12, 16 and 17, Bell discloses a method for promoting tunneling of electrons having an energy level higher than the Fermi level of an emitter electrode (35 in Fig. 8) (col. 4, line 59) from an emitter electrode surface, comprising the step of positioning a collector electrode (composite layer of 25-27) (col. 3, lines 56-62)

consisting of a band gap material at a distance within a tunneling range of the electrons, the band gap material (composite layer of 25-27) being a crystal material having filled zero temperature valence band and empty conductive band, wherein the band gap material (composite layer of 25-27) is a semiconductor such as GaAs (col. 4, lines 60-62), and the emitter electrode (35) is separated from the collector electrode (composite layer of 25-27) by a gap, the gap containing only a vacuum (col. 4, lines 58-59).

Bell differs from the claimed invention by not showing that the emitter electrode comprises a metal.

It would have been obvious, if not inherent, to the one of ordinary skill in the art at the time the invention was made that the emitter electrode disclosed by Bell may comprise a metal, because a metal is commonly used as an emitter electrode material to release electrons.

Regarding claim 13, Bell discloses a method for suppressing back tunneling of electrons in a tunnel diode (Figs. 2 and 8) comprising the step of coating a collector (28 in Fig. 2) (col. 3, lines 55-56 and 62) with a layer of a band gap material (composite layer of 25-27) (col. 3, lines 56-62), the band gap material being a crystal material having filled zero temperature valence band and empty conductive band, and the collector (28) being separated from an emitter (35) (col. 4, line 59) by a gap, the gap containing only a vacuum (col. 4, lines 58-59).

Bell differs from the claimed invention by not showing that the emitter electrode comprises a metal.

It would have been obvious, if not inherent, to the one of ordinary skill in the art at the time the invention was made that the emitter electrode disclosed by Bell may comprise a metal, because a metal is commonly used as an emitter electrode material to release electrons.

13. Claims 7, 8, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cox (US 6,064,137) in view of Tavkhelidze et al. (US 6,417,060). The teachings of Cox et al. are discussed above.

Regarding claims 7, 8, 18 and 19, Cox differs from the claimed invention by not showing that the gap is in the range 1-100nm (claim 7), that the gap is in the range 1-10nm (claim 8), that the collector and the emitter are separated by a gap in the range 1-100 nm (claim 18), and that the collector and the emitter are separated by a gap in the range 1-10 nm (claim 19).

Tavkhelidze et al. disclose a tunnel diode (Fig. 2) comprising an emitter (5) (col. 3, line 33) and a collector (1) (col. 3, line 35), wherein the emitter (5) and the collector (1) are separated by a gap in the range 50 nm or less, preferably 5 nm or less (lines 9-12 of ABSTRACT).

Since both Cox and Tavkhelidze et al. teach a tunnel diode, it would have been obvious to the one of ordinary skill in the art at the time the invention was made that the emitter and the collector disclosed by Cox may be separated by a gap in the range disclosed by Tavkhelidze et al., for example, ~50 nm or ~ 5 nm, because the gap

distance between the emitter and the collector in the tunnel diode can be varied to control electron tunneling and thus the performance of the tunnel diode.

Further regarding claim 7, 8, 18 and 19, the claims are prima facie obvious without showing that the claimed ranges of the gap achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

14. Claims 7, 8, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bell (US 4,280,074) in view of Tavkhelidze et al. (US 6,417,060). The teachings of Bell et al. are discussed above.

Regarding claims 7, 8, 18 and 19, Bell differs from the claimed invention by not showing that the gap is in the range 1-100nm (claim 7), that the gap is in the range 1-10nm (claim 8), that the collector and the emitter are separated by a gap in the range 1-100 nm (claim 18), and that the collector and the emitter are separated by a gap in the range 1-10 nm (claim 19).

Tavkhelidze et al. disclose a tunnel diode (Fig. 2) comprising an emitter (5) (col. 3, line 33) and a collector (1) (col. 3, line 35), wherein the emitter (5) and the collector (1) are separated by a gap in the range 50 nm or less, preferably 5 nm or less (lines 9-12 of ABSTRACT).

Since both Bell and Tavkhelidze et al. teach a tunnel diode, it would have been obvious to the one of ordinary skill in the art at the time the invention was made that the electrodes disclosed by Bell may be separated by a gap in the range disclosed by Tavkhelidze et al., for example, ~ 50 nm or ~ 5 nm, because the gap distance between the electrodes in the tunnel diode can be varied to control electron tunneling and thus the performance of the tunnel diode.

Further regarding claim 7, 8, 18 and 19, the claims are prima facie obvious without showing that the claimed ranges of the gap achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

Double Patenting

13. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

14. Claims 1, 3-8, 10-19 and 21 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-9 and 11-15 of copending Application No. 11/392,182. Although the conflicting claims are not identical, they are not patentably distinct from each other because claims 1-9 and 11-15 of Application No. 11/392,182 include all the recited limitations of claims 1, 3-8, 10-19 and 21 of current Application.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

15. Applicants' arguments filed September 8, 2008 have been fully considered but they are not persuasive.

Applicants argue that "since Cox requires a diamond material coating on both electrodes whereas the present invention, as recited in claims 1, 3, 5, 10-14 and 16 has a band-gap material on one electrode only, the present invention is capable of functioning with fewer elements than the prior art and is therefore distinguishable over the prior art". Applicants do not claim a specific structure and a specific function of the collector electrode, and therefore the diamond material 6 disclosed by Cox may be referred to as a collector electrode as stated in rejection of claims 1 and 12, because the diamond material 6 can collect electrons.

Applicants argue that "furthermore, it can be seen from Figures 1, 1A, 3 and 3B of the present invention, and the associated descriptive text, that the emitter and collector are separated by a gap which does contain any solid state material, such as spacers as in the prior art of Cox, but rather is filled only with an inert gas at low pressure or is evacuated". Claims 1, 12 and 13 recite *a gap* or any type of gap separating an emitter electrode and a collector electrode, but do not recite whether another structure exists outside of the gap. Also, Applicants do not claim specifically that there are no spacers holding the side surfaces of the emitter and the collector.

Applicants argue that "Cox's anode comprises an additional metal base layer in comparison to the collector or anode of the present invention which can function comprising a band gap material alone". See the above response.

Applicants argue that "in claims 1, 3-6 and 10-17 of the present invention, the collector electrode does not comprise a cesiated layer", and that "this is made clear by the amendments to claims 1, 12 and 13 in which the collector electrode is recited as consisting of a band gap material, which clearly precludes it consisting of a cesiated layer which is metallic". The Examiner did not refer to the cesiated surface layer as a collector electrode, but rather used a composite layer of 25-27 in Fig. 2 of Bell as a collector electrode.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAY C. KIM whose telephone number is (571)270-1620. The examiner can normally be reached on 7:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. K./
Examiner, Art Unit 2815
November 18, 2008

/Jerome Jackson Jr./
Primary Examiner, Art Unit 2815